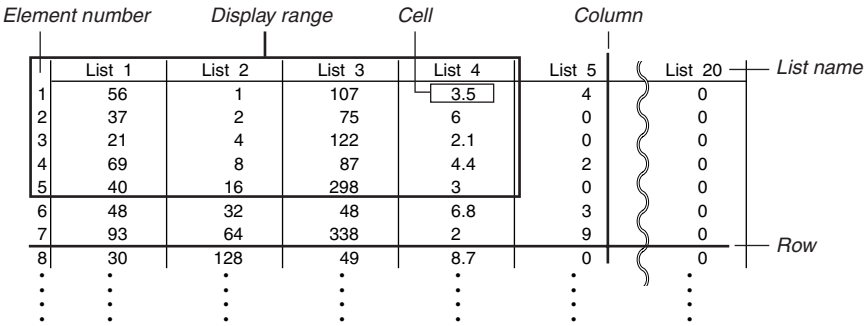
Chapter 3

List Function

A list is a storage place for multiple data items.
This calculator lets you store up to 20 lists in a single file, and you can store up to six files in memory. Stored lists can be used in arithmetic and statistical calculations, and for graphing.



3-1 Inputting and Editing a List

3-2 Manipulating List Data

3-3 Arithmetic Calculations Using Lists

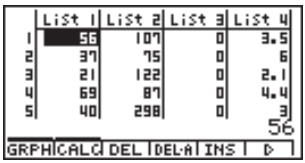
3-4 Switching Between List Files

3-1 Inputting and Editing a List

Enter the **STAT** Mode from the Main Menu to input data into a list and to manipulate list data.

• To input values one-by-one

Use the cursor keys to move the highlighting to the list name or cell you want to select.



The screen automatically scrolls when the highlighting is located at either edge of the screen.

The following example is performed starting with the highlighting located at Cell 1 of List 1.

1. Input a value and press [EXE] to store it in the list.

   [3] [EXE]

   • The highlighting automatically moves down to the next cell for input.

2. Input the value 4 in the second cell, and then input the result of 2 + 3 in the next cell.

   [4] [EXE] [2] [+] [3] [EXE]

You can also input the result of an expression or a complex number into a cell.

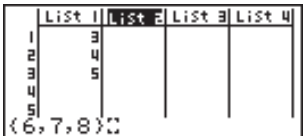
You can input value for up to 255 cells in a single list.

● To batch input a series of values

1. Use the cursor keys to move the highlighting to another list.

2. Press SHIFT × ({), and then input the values you want, pressing , between each one. Press SHIFT ÷ (}) after inputting the final value.

SHIFT × ({) 6 , 7 , 8 SHIFT ÷ (})

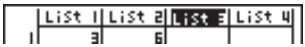


3. Press EXE to store all of the values in your list.

EXE

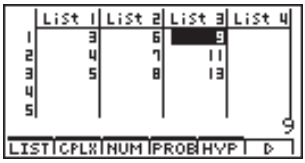
You can also use list names inside of a mathematical expression to input values into another cell. The following example shows how to add the values in each row in List 1 and List 2, and input the result into List 3.

1. Use the cursor keys to move the highlighting to the name of the list where you want the calculation results to be input.



2. Press OPTN and input the expression.

OPTN F1 (LIST) 1 (List) 1 +
OPTN F1 (LIST) 1 (List) 2 EXE



You can also use SHIFT 1 (List) in place of OPTN F1 (LIST) 1 (List).

Remember that a comma separates values, so you should not input a comma after the final value of the set you are inputting.

Right: {34, 53, 78}

Wrong: {34, 53, 78,}

■ Editing List Values

● To change a cell value

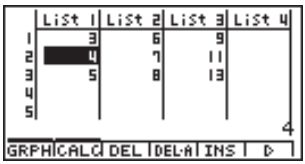
Use ◀ or ▶ to move the highlighting to the cell whose value you want to change. Input the new value and press [EXE] to replace the old data with the new one.

● To edit the contents of a cell

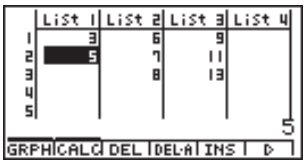
1. Use the cursor keys to move the highlighting to the cell whose contents you want to edit.
2. Press [F6] (▷) [F2] (EDIT) to display the contents of the cell at the bottom of the screen.
3. Make any changes in the data you want.

● To delete a cell

1. Use the cursor keys to move the highlighting to the cell you want to delete.



2. Press [F3] (DEL) to delete the selected cell and cause everything below it to be shifted up.



The cell delete operation does not affect cells in other lists. If the data in the list whose cell you delete is somehow related to the data in neighboring lists, deleting a cell can cause related values to become misaligned.

● To delete all cells in a list

Use the following procedure to delete all the data in a list.

1. Use the cursor key to move the highlighting to any cell of the list whose data you want to delete.
2. Pressing [F4](DEL•A) causes a confirmation message to appear.
3. Press [EXE](Yes) to delete all the cells in the selected list or [ESC](No) to abort the delete operation without deleting anything.

● To insert a new cell

1. Use the cursor keys to move the highlighting to the location where you want to insert the new cell.

2. Press [F5](INS) to insert a new cell, which contains a value of 0, causing everything below it to be shifted down.

The cell insert operation does not affect cells in other lists. If the data in the list where you insert a cell is somehow related to the data in neighboring lists, inserting a cell can cause related values to become misaligned.

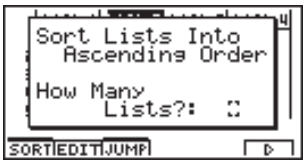
■ Sorting List Values

You can sort lists into either ascending or descending order. The highlighting can be located in any cell of the list.

• To sort a single list

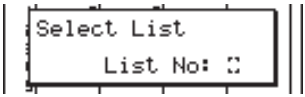
Ascending order

1. While the lists are on the screen, press [F6](▷)[F1](SORT)[1](SortA).



2. The prompt "How Many Lists?: " appears to ask how many lists you want to sort. Here we will input 1 to indicate we want to sort only one list.

[1] [EXE]



3. In response to the "Select List List No: " prompt, input the number of the list you want to sort.

[1] [EXE]

Descending order

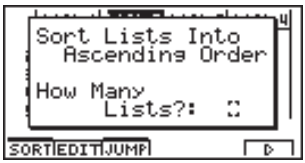
Use the same procedure as that for the ascending order sort. The only difference is that you should press [2](SortD) in place of [1](SortA).

● To sort multiple lists

You can link multiple lists together for a sort so that all of their cells are rearranged in accordance with the sorting of a base list. The base list is sorted into either ascending order or descending order, while the cells of the linked lists are arranged so that the relative relationship of all the rows is maintained.

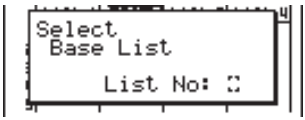
Ascending order

1. While the lists are on the screen, press [F6](▷)[F1](SORT)[1](SortA).



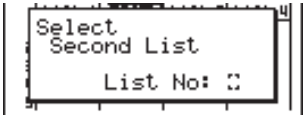
2. The prompt “How Many Lists?: ” appears to ask how many lists you want to sort. Here we will sort one base list linked to one other list, so we should input 2.

[2] [EXE]



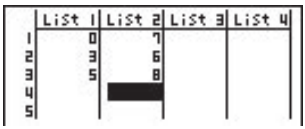
3. In response to the “Select Base List List No: ” prompt, input the number of the list you want to sort into ascending order. Here we will specify List 1.

[1] [EXE]



4. In response to the “Select Second List List No:” prompt, input the number of the list you want to link to the base list. Here we will specify List 2.

[2] [EXE]



Descending order

Use the same procedure as that for the ascending order sort. The only difference is that you should press [2] (SortD) in place of [1] (SortA).

You can specify a value from 1 to 6 as the number of lists for sorting.

If you specify a list more than once for a single sort operation, an error occurs.

An error also occurs if lists specified for sorting do not have the same number of values (rows).

Specifying a value of 0 for the number of lists causes all the lists in the file to be sorted. In this case you specify a base list on which all other lists in the file are sorted.

3-2 Manipulating List Data

List data can be used in arithmetic and function calculations. In addition, various list data manipulation functions makes manipulation of list data quick and easy.

You can use list data manipulation functions in the **RUN•MAT**, **STAT**, **GRPH•TBL**, **EQUA** and **PRGM Modes**.

■ Accessing the List Data Manipulation Function Menu

All of the following examples are performed after entering the **RUN•MAT Mode**.

Press [OPTN] and then [F1](LIST) to display the list data manipulation menu, which contains the following items.

- {**List**}/{**Dim**}/{**Seq**}/{**Min**}/{**Max**}/{**Mean**}/{**Median**}/{**Sum**}/{**Prod**}/{**Cuml**}/{**%**}/{**⊿List**}/{**Augmnt**}/{**Fill**}/{**L→Mat**}

Note that all closing parentheses at the end of the following operations can be omitted.

• To count the number of data items in a list

[OPTN]-[LIST]-[Dim]

[OPTN] [F1](LIST) [2](Dim) [F1](LIST) [1](List) <list number 1-20> [EXE]

- The number of cells a list contains is its "dimension."

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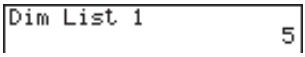
Example **To count the number of values in List 1 (36, 16, 58, 46, 56)**

[AC] [OPTN] [F1](LIST) [2](Dim)
[F1](LIST) [1](List) [1] [EXE]



• To create a list or matrix by specifying the number of data items

[OPTN]-[LIST]-[Dim]

Use the following procedure to specify the number of data in the assignment statement and create a list.

<number of data *n*>[→] [OPTN] [F1](LIST) [2](Dim) [F1](LIST) [1](List)
<list number 1-20> [EXE]

n = 1 ~ 255

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Example **To create five data items (each of which contains 0) in List 1**

AC 5 → OPTN F1 (LIST) 2 (Dim)
F1 (LIST) 1 (List) 1 EXE

You can view the newly created list by entering the STAT Mode.

Use the following procedure to specify the number of data rows and columns, and the matrix name in the assignment statement and create a matrix.

SHIFT × ({) <number of row m> , <number of column n> SHIFT ÷ (}) →
OPTN F1 (LIST) 2 (Dim) F2 (MAT) 1 (Mat) ALPHA <matrix name> EXE
m, n = 1 ~ 255, matrix name; A ~ Z

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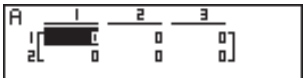
Example **To create a 2-row × 3-column matrix (each cell of which contains 0) in Matrix A**

AC SHIFT × ({) 2 , 3 SHIFT ÷ (}) →
OPTN F1 (LIST) 2 (Dim)
F2 (MAT) 1 (Mat) ALPHA X,θ,T (A) EXE

The following shows the new contents of Mat A.



• To replace all data items with the same value **[OPTN]-[LIST]-[Fill]**

OPTN F1 (LIST) cos (Fill) <value> , F1 (LIST) 1 (List) <list number 1-20>) EXE

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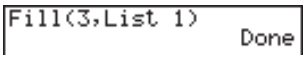
Example **To replace all data items in List 1 with 3**

AC OPTN F1 (LIST) cos (Fill)
3 , F1 (LIST) 1 (List) 1) EXE



The following shows the new contents of List 1.

• To generate a sequence of numbers [OPTN]-[LIST]-[Seq]

OPTN F1 (LIST) 3 (Seq) <expression> , <variable name> , <start value> , <end value> , <increment>) EXE

- The result of this operation is stored in ListAns Memory.

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Example **To input the number sequence 1^2, 6^2, 11^2, into a list, using the function $f(x) = X^2$. Use a starting value of 1, an ending value of 11, and an increment of 5**

AC OPTN F1 (LIST) 3 (Seq) X,θ,T x^2 ,
X,θ,T , 1 , 1 1 , 5) EXE

Specifying an ending value of 12, 13, 14, or 15 produces the same result as shown above, because all of them are less than the value produced by the next increment (16).

• To find the minimum value in a list [OPTN]-[LIST]-[Min]

OPTN F1 (LIST) 4 (Min) F1 (LIST) 1 (List) <list number 1-20>) EXE

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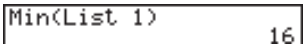
Example **To find the minimum value in List 1 (36, 16, 58, 46, 56)**

AC OPTN F1 (LIST) 4 (Min)
F1 (LIST) 1 (List) 1) EXE



• To find the maximum value in a list [OPTN]-[LIST]-[Max]

Use the same procedure as when finding the minimum value (Min), except press 5 (Max) in place of 4 (Min).

• To find which of two lists contains the smallest value [OPTN]-[LIST]-[Min]

OPTN F1 (LIST) 4 (Min) F1 (LIST) 1 (List) <list number 1-20>
, F1 (LIST) 1 (List) <list number 1-20>) EXE

- The two lists must contain the same number of data items. If they don't, an error occurs.
- The result of this operation is stored in ListAns Memory.

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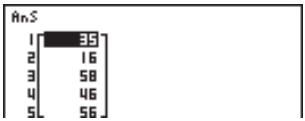
Example **To find whether List 1 (75, 16, 98, 46, 56) or List 2 (35, 59, 58, 72, 67) contains the smallest value**

OPTN F1 (LIST) 4 (Min)
F1 (LIST) 1 (List) 1 ,
F1 (LIST) 1 (List) 2) EXE



• To find which of two lists contains the greatest value [OPTN]-[LIST]-[Max]

Use the same procedure as that for the smallest value, except press 5 (Max) in place of 4 (Min).

- The two lists must contain the same number of data items. If they don't, an error occurs.

• To calculate the mean of data items [OPTN]-[LIST]-[Mean]

OPTN F1 (LIST) 6 (Mean) F1 (LIST) 1 (List) <list number 1-20>) EXE

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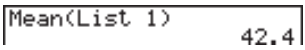
Example **To calculate the mean of data items in List 1 (36, 16, 58, 46, 56)**

AC OPTN F1 (LIST) 6 (Mean)
F1 (LIST) 1 (List) 1) EXE



• To calculate the mean of data items of specified frequency [OPTN]-[LIST]-[Mean]

This procedure uses two lists: one that contains values and one that indicates the frequency (number of occurrences) of each value. The frequency of the data in Cell 1 of the first list is indicated by the value in Cell 1 of the second list, etc.

- The two lists must contain the same number of data items. If they don't, an error occurs.

OPTN F1 (LIST) 6 (Mean) F1 (LIST) 1 (List)<list number 1-20 (data)>
, F1 (LIST) 1 (List)<list number 1-20 (frequency)>) EXE

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Example **To calculate the mean of data items in List 1 (36, 16, 58, 46, 56), whose frequency is indicated by List 2 (75, 89, 98, 72, 67)**

AC OPTN F1 (LIST) 6 (Mean)
F1 (LIST) 1 (List) 1 ,
F1 (LIST) 1 (List) 2) EXE

```
Mean(List 1,List 2)
                42.07481297
```

• To calculate the median of data items in a list

[OPTN]-[LIST]-[Med]

OPTN F1 (LIST) 7 (Median) F1 (LIST) 1 (List)<list number 1-20>) EXE

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Example **To calculate the median of data items in List 1 (36, 16, 58, 46, 56)**

AC OPTN F1 (LIST) 7 (Median)
F1 (LIST) 1 (List) 1) EXE

```
Median(List 1)
                46
```

• To calculate the median of data items of specified frequency

[OPTN]-[LIST]-[Med]

This procedure uses two lists: one that contains values and one that indicates the frequency (number of occurrences) of each value. The frequency of the data in Cell 1 of the first list is indicated by the value in Cell 1 of the second list, etc.

- The two lists must contain the same number of data items. If they don't, an error occurs.

OPTN F1 (LIST) 7 (Median) F1 (LIST) 1 (List) <list number 1-20 (data)>
, F1 (LIST) 1 (List) <list number 1-20 (frequency)>) EXE

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Example **To calculate the median of values in List 1 (36, 16, 58, 46, 56), whose frequency is indicated by List 2 (75, 89, 98, 72, 67)**

AC OPTN F1 (LIST) 7 (Median)
F1 (LIST) 1 (List) 1 ,
F1 (LIST) 1 (List) 2) EXE

```
Median(List 1,List 2)
                46
```

• To calculate the sum of data items in a list

[OPTN]-[LIST]-[Sum]

[OPTN] [F1](LIST) [8](Sum) [F1](LIST) [1](List)<list number 1-20> [EXE]

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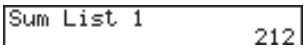
Example **To calculate the sum of data items in List 1 (36, 16, 58, 46, 56)**

[AC] [OPTN] [F1](LIST) [8](Sum)
[F1](LIST) [1](List) [1] [EXE]



• To calculate the cumulate product of a list

[OPTN]-[LIST]-[Prod]

[OPTN] [F1](LIST) [9](Prod) [F1](LIST) [1](List)<list number 1-20> [EXE]

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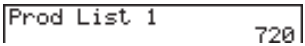
Example **To calculate the cumulative product of the data in List 1 (2, 3, 6, 5, 4)**

[AC] [OPTN] [F1](LIST) [9](Prod)
[F1](LIST) [1](List) [1] [EXE]



• To calculate the cumulative frequency of each data item

[OPTN]-[LIST]-[Cuml]

[OPTN] [F1](LIST) [X,θ,T](Cuml) [F1](LIST) [1](List) <list number 1-20> [EXE]

• The result of this operation is stored in ListAns Memory.

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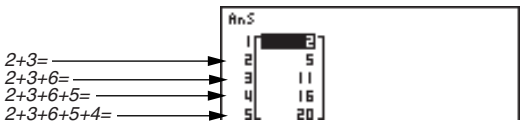
Example **To calculate the cumulative frequency of each data item in List 1 (2, 3, 6, 5, 4)**

[AC] [OPTN] [F1](LIST) [X,θ,T](Cuml)
[F1](LIST) [1](List) [1] [EXE]



• To calculate the percentage represented by each data item

[OPTN]-[LIST]-[%]

OPTN F1 (LIST) log (%) F1 (LIST) 1 (List)<list number 1-20> EXE

- The above operation calculates what percentage of the list total is represented by each data item.
- The result of this operation is stored in ListAns Memory.

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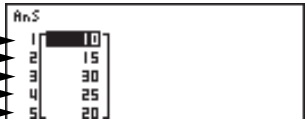
Example **To calculate the percentage represented by each data item in List 1 (2, 3, 6, 5, 4)**

AC OPTN F1 (LIST) log (%)
F1 (LIST) 1 (List) 1 EXE

2/(2+3+6+5+4) × 100 =
3/(2+3+6+5+4) × 100 =
6/(2+3+6+5+4) × 100 =
5/(2+3+6+5+4) × 100 =
4/(2+3+6+5+4) × 100 =



• To calculate the differences between neighboring data inside a list

[OPTN]-[LIST]-[⊿List]

OPTN F1 (LIST) ln (⊿List)<list number 1-20> EXE

- The result of this operation is stored in ListAns memory.

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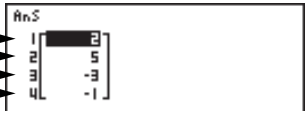
Example **To calculate the difference between the data items in List 1 (1, 3, 8, 5, 4)**

AC OPTN F1 (LIST) ln (⊿List)
1 EXE

3 – 1 =
8 – 3 =
5 – 8 =
4 – 5 =



You can specify the location of the new list (List 1 through List 20) with a statement like: ⊿ List 1 → List 2. You cannot specify another memory or ListAns as the destination of the ⊿ List operation. An error also occurs if you specify a ⊿ List as the destination of the results of another ⊿ List operation.

The number of cells in the new ⊿ List is one less than the number of cells in the original list.

An error occurs if you execute ⊿ List for a list that has no data or only one data item.

• To combine lists [OPTN]-[LIST]-[Augmnt]

•You can combine to different lists into a single list. The result of a list combination operation is stored in ListAns memory.

OPTN F1 (LIST) sin (Augmnt) F1 (LIST) 1 (List) < list number 1-20 >
, F1 (LIST) 1 (List) < list number 1-20 >) EXE

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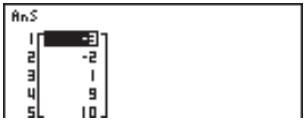
Example **To combine the List 1 (–3, –2) and List 2 (1, 9, 10)**

AC OPTN F1 (LIST) sin (Augmnt)
F1 (LIST) 1 (List) 1 ,
F1 (LIST) 1 (List) 2) EXE



• To transfer list contents to Matrix Answer Memory [OPTN]-[LIST]-[L→Mat]

OPTN F1 (LIST) tan (L→Mat) F1 (LIST) 1 (List) <list number 1-20>
, F1 (LIST) 1 (List) <list number 1-20>) EXE

• You can skip input F1 (LIST) 1 (List) in the part of the above operation.

Example: List → Mat (1, 2) EXE

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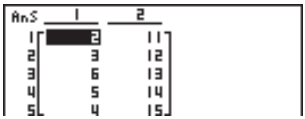
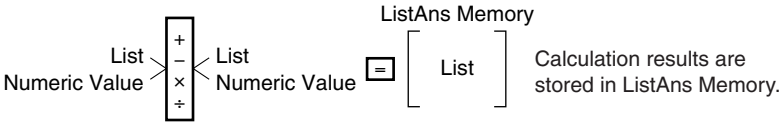
Example **To transfer the contents of List 1 (2, 3, 6, 5, 4) to column 1, and the contents of List 2 (11, 12, 13, 14, 15) to column 2 of Matrix Answer Memory**

AC OPTN F1 (LIST) tan (L→Mat)
F1 (LIST) 1 (List) 1 ,
F1 (LIST) 1 (List) 2) EXE



3-3 Arithmetic Calculations Using Lists

You can perform arithmetic calculations using two lists or one list and a numeric value.



■ Error Messages

- A calculation involving two lists performs the operation between corresponding cells. Because of this, an error occurs if the two lists do not have the same number of values (which means they have different "dimensions").
- An error occurs whenever an operation involving any two cells generates a mathematical error.

■ Inputting a List into a Calculation

There are two methods you can use to input a list into a calculation.

• To input a specific list by name

1. Press [OPTN] to display the first Operation Menu.
   - This is the function key menu that appears in the **RUN•MAT Mode** when you press [OPTN].

2. Press [F1] (LIST) to display the List Data Manipulation Menu.
3. Press [1] (List) to display the "List" command and input the number of the list you want to specify.

• To directly input a list of values

You can also directly input a list of values using {, }, and [,].

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Example 1 To input the list: 56, 82, 64

[SHIFT] [×] ({) [5] [6] [,] [8] [2] [,] [6] [4] [SHIFT] [÷] (}) → {56,82,64}

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Example 2 To multiply List 3 $\left(= \begin{bmatrix} 41 \\ 65 \\ 22 \end{bmatrix}\right)$ by the list $\begin{bmatrix} 6 \\ 0 \\ 4 \end{bmatrix}$

[OPTN] [F1] (LIST) [1] (List) [3] [×] [SHIFT] [×] ({) [6] [,] [0] [,] [4] [SHIFT] [÷] (}) [EXE]

The resulting list $\begin{bmatrix} 246 \\ 0 \\ 88 \end{bmatrix}$ is stored in ListAns Memory.

• To assign the contents of one list to another list

Use [→] to assign the contents of one list to another list.

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Example 1 To assign the contents of List 3 to List 1

[OPTN] [F1] (LIST) [1] (List) [3] [→] [F1] (LIST) [1] (List) [1] [EXE]

In place of [OPTN] [F1] (LIST) [1] (List) [3] operation in the above procedure, you could input [SHIFT] [×] ({) [4] [1] [,] [6] [5] [,] [2] [2] [SHIFT] [÷] (}).

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Example 2 To assign the list in ListAns Memory to List 1

[OPTN] [F1] (LIST) [1] (List) [SHIFT] [(-)] (Ans) [→] [F1] (LIST) [1] (List) [1] [EXE]

• To recall the value in a specific list cell

You can recall the value in a specific list cell and use it in a calculation. Specify the cell number by enclosing it inside square brackets.

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Example **To calculate the sine of the value stored in Cell 3 of List 2**

sin OPTN F1 (LIST) 1 (List) 2 SHIFT + ([ ) 3 SHIFT − ( ]) EXE

• To input a value into a specific list cell

You can input a value into a specific list cell inside a list. When you do, the value that was previously stored in the cell is replaced with the new value you input.

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Example **To input the value 25 into Cell 2 of List 3**

2 5 → OPTN F1 (LIST) 1 (List) 3 SHIFT + ([ ) 2 SHIFT − ( ]) EXE

■ Recalling List Contents

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Example **To recall the contents of List 1**

OPTN F1 (LIST) 1 (List) 1 EXE

- The above operation displays the contents of the list you specify and also stores them in ListAns Memory. You can then use the ListAns Memory contents in a calculation.

• To use list contents in ListAns Memory in a calculation

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Example **To multiply the list contents in ListAns Memory by 36**

OPTN F1 (LIST) 1 (List) SHIFT (–) (Ans) × 3 6 EXE

- The operation OPTN F1 (LIST) 1 (List) SHIFT (–) (Ans) recalls ListAns Memory contents.
- This operation replaces current ListAns Memory contents with the result of the above calculation.

■ Graphing a Function Using a List

When using the graphing functions of this calculator, you can input a function such as Y1 = List 1 X. If List 1 contains the values 1, 2, 3, this function will produces three graphs: Y = X, Y = 2X, Y = 3X.

There are certain limitations on using lists with graphing functions.

■ Inputting Scientific Calculations into a List

You can use the numeric table generation functions in the Table & Graph Menu to input values that result from certain scientific function calculations into a list. To do this, first generate a table and then use the list copy function to copy the values from the table to the list.

■ Performing Scientific Function Calculations Using a List

Lists can be used just as numeric values are in scientific function calculations. When the calculation produces a list as a result, the list is stored in ListAns Memory.

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Example **To use List 3** $\begin{bmatrix} 41 \\ 65 \\ 22 \end{bmatrix}$ **to perform sin (List 3)**

Use radians as the angle unit.

[sin] [OPTN] [F1] (LIST) [1] (List) [3] [EXE]

The resulting list $\begin{bmatrix} -0.158 \\ 0.8268 \\ -8E{-}3 \end{bmatrix}$ is stored in ListAns Memory.

In place of the [OPTN] [F1] (LIST) [1] (List) [3] operation in the above procedure, you could input [SHIFT] [×] ({) [4] [1] [,] [6] [5] [,] [2] [2] [SHIFT] [÷] (}).

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Example **To use List 1** $\begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$ **and List 2** $\begin{bmatrix} 4 \\ 5 \\ 6 \end{bmatrix}$ **to perform List 1$^{\text{List 2}}$**

This creates a list with the results of 1^4, 2^5, 3^6.

OPTN F1 (LIST) 1 (List) 1 ^ F1 (LIST) 1 (List) 2 EXE

The resulting list $\begin{bmatrix} 1 \\ 32 \\ 729 \end{bmatrix}$ is stored in ListAns Memory.

3-4 Switching Between List Files

You can store up to 20 lists (List 1 to List 20) in each file (File 1 to File 6). A simple operation lets you switch between list files.

• To switch between list files

1. From the Main Menu, enter the STAT Mode.
   Press [CTRL] [F3] (SET UP) to display the STAT Mode SET UP screen.

2. Press [F1] (FILE) and then input the number of the list file you want to use.

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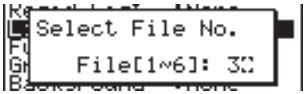
Example **To select File 3**

[F1] (FILE) [3]



[EXE]

All subsequent list operations are applied to the lists contained in the file you select (List File 3 in the above example).